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Christensen, Ole Ravn; Valero, Paola; Stentoft, Diana

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Ole Ravn Christensen,
Diana Stentoft & Paola Valero

Department of Education, Learning and Philosophy

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Department of Education, Learning and Philosophy
Aalborg University
Fibigerstræde 10
DK 9220 Aalborg
Tel +45 9635 9950 – Fax +45 9815 6542
learning@learning.aau.dk
www.learning.aau.dk

# Contents

# Introduction

In this working paper we have comprised our drafts for two contributions to the book *Opening the research text: Critical insights and in(ter)ventions into mathematics education* (Springer, forthcoming) edited by Elizabeth de Freitas, Faculty of Education, University of Prince Edward Island, Charlottetown, and Kathleen Nolan, Faculty of Education, University of Regina, Regina, in Canada.

*Opening the research text: Critical insights and in(ter)ventions into mathematics education* is a research-based book on mathematics education and research methodology. The book will consist in several research chapters that will be complemented with responses, building on and extending the discussion found in each research paper. Each response is thereby meant to complement the research paper by triggering critical reflection, dialogue and action regarding the lived experience of mathematics education.

The book also aims to contribute to the mathematics education research community by illustrating specific poststructuralist reading strategies that have proven their value in curriculum theory and other areas of educational research. The book is poststructural because it endeavours to open up research texts and generate diverse reading practices that are both inventions and interpretations. The editors have tried to create a dialogic text in which a variety of voices and positions are enacted in order to expand on and develop the important socio-cultural work that is gradually being explored in mathematics education research. The editors add that "This book will create more openings than closures, and will do so by actively and critically engaging the reader in multiple ways, thereby reaching different readers differently. The "insights and in(ter)ventions" are not intended as authoritative applications of the more theoretical research text, but rather as sufficiently ambiguous and multi-directional supplements that challenge reader ambivalence and engender dialogue."

Some of the topics of the book are Difference and diversity, Power dynamics, Classroom discourse, Teacher and student identity, Social justice and curriculum, Post-positivist research practices to name a few. The editors have invited a variety of response formats, e.g. A fictional account, An autobiographical narrative, An interview with the researcher, A transcript of a focus group discussion or A conversation.

In the following we present our two drafts for contributions to the book. First comes the research chapter "Power Distribution in the Network of Mathematics Education Practices" and secondly our own response to this chapter, "A Landscape of Power Distribution", that opens up the research text.

# Power Distribution in the Network of Mathematics Education Practices

Abstract: The importance of mathematics and mathematics education in current societies is associated with them being seen as “powerful”. The meaning of power is, however, not always explicitly expressed or easy to define in a clear-cut way. In this chapter we trace three different perspectives of thinking about power in relation to mathematics education, as they are expressed in the network of mathematics education practices. The intrinsic perspective, the technical perspective and the structural inequality perspective represent three different ways of seeing what power is and how it is distributed. Highlighting these perspectives helps us investigate the constraints and potentials of different ways of conceiving mathematics education and construct new imaginaries for the future.

Educating people in mathematics is considered a powerful enterprise. ‘Mathematics is at the core of Western culture’. ‘Mathematics is a powerful tool to reinforce and secure access to the material, economic and the social world’. Statements of this nature frequently appear in discussions on the role of mathematics in the construction and consolidation of a modern, industrialized and democratic society. Even though modern societies have entered into a post-industrial era, such statements are still at the core of justification for allocating funds for mathematics education and for improving the teaching of mathematics at all educational levels. Where mathematics used to be a tool for building infrastructure and developing industry, it has gradually become a tool for building the informational infrastructure and advanced communication technologies. In this sense mathematics is continuously perceived as a prerequisite for progress and wealth.

Thinking in terms of *mathematics* as powerful immediately grants power to *mathematics education* as a privileged social practice through which children and adults alike will come to know about mathematics. But what is the meaning of the term power when connected with mathematics and mathematics education? How and by whom is this power exercised? What are the consequences of power for participants in the practices of mathematics education? On the following pages we will address these questions with a view to demonstrate that it is not a straightforward issue to talk about power in relation to mathematics education. Instead we argue that power is complexly distributed across the entire *network of mathematics education practices*. By this term we refer to the network of language games that, intertwined by family resemblances, constitute mathematics education; from social interaction at a micro level, such as classroom interactions, to practices at macro levels of society at large, such as political decision making, labour market needs and even mathematics education research[1].

In this chapter, we focus on three perspectives on power found in the network of mathematics education practices and often addressed in mathematics education research: an intrinsic perspective, a technical perspective, and a structural inequality

[1] The notion of network of mathematics education practices has been discussed in Valero (2002, 2007)

perspective. The exploration of these three perspectives serves as our analytical lens through which we observe the enactment and distribution of power in the network of mathematics education practices. These different perspectives set the scene for constructions of distinct imaginaries about what mathematics and its educational practices are about. Furthermore, the perspectives are not limited to one particular type or level of practice where 'proper' mathematics education practice resides. Rather, these perspectives on power in the network of mathematics education practices also serve as a framework for connecting practices across micro and macro levels that may not traditionally be thought of as interrelated.

## Three Perspectives on Power in Mathematics Education Practices

Researchers' perceptions of power and power distribution in mathematics education are not always explicit. They remain implicit parts of the fundamental assumptions about mathematics education with its objects and subjects of research and their justifications and contributions to particular studies. However, researchers' perceptions are of extreme relevance since they, to a considerable extent, determine how a researcher constructs and presents mathematics education and its achievements, shortcomings and development to society, politicians and education practitioners. A deeper understanding of power as it is distributed and enacted in the web of everyday practices surrounding mathematics education is therefore needed.

Traditionally, many scholars in mathematics education have applied a structuralist perspective when examining power. The source of power of mathematics and its learning has traditionally been seen as residing in one of three places: in the logical structures of mathematics, in cognitive structures of the learner, or in the traditional social and cultural structures and categories such as gender, class and race[2]. Such a perspective emphasizes a view of power as a monolithic entity which individuals may/may not possess according to their own personal attributes or their relation to surrounding structures, and which individuals may/may not decide to exercise. In recent explorations of power in mathematics education the researcher is challenged to deconstruct the existing practices in a way that will reveal how power operates in various educational practices. Through this approach researchers wish to demonstrate the way in which participants in various practices create different ways of relating to and with mathematics and mathematics education for achieving different goals. From this approach, power is seen as rooted in social interactions, as being in constant movement and as being distributed among the participants in social practices constituting the network of mathematics education practices. This perspective can be termed post-structural and is occupied with power distribution – and not power possession[3].

We will now clarify the three perspectives on power in mathematics education practices, and how they are acted out and distributed in people's everyday involvement with mathematics education. The three perspectives on power have

[2] For details on the discussion of different views of powerful mathematical ideas see Skovsmose and Valero (2002).

[3] For examples of this trend see De Freitas (2004) and the different chapters in Walshaw (2004).

emerged from our examination of ways of talking[4] about power in mathematics education research literature and in mathematics education practices outside the research environment. We choose to present the main features of these discourses by playing with a mix of fictional narrative constructions and our supplementary analysis. This approach allows us to bring ideas about power and power distribution in mathematics education research in close contact with educational practices and to illustrate through a variety of scenarios the constant interplay between micro and macro levels of practices that characterize the network of mathematics education practices.

## The intrinsic perspective

It is a hot summer day in the northern hemisphere. In a high school mathematics classroom, pupils are doing trigonometry and it's difficult. Only a few seem to engage with the assignment that has just been handed out by the teacher. He is waiting to see how they cope with it before throwing a helping hand to those in trouble. Most of the students are not making much progress. They are having a hard time dealing with the sine and cosine functions and actually only a fraction of them has really understood what the assignment demands. Instead, they are focusing on each other and on people that are not in the classroom right now…

Teacher (thinking): I have to remember to leave the car keys behind for Line, otherwise she won't be able to pick up the kids tomorrow…

Ali (a pupil) is on the verge of texting from his mobile phone….

Teacher: Ali STOP THAT right now or I will confiscate your mobile!

Ali (thinking but saying it all aloud with his eyes): Fuck you, man! Can't you see I'm busy? I have to find some way to join the party on Friday. I won't let Maria be there alone… Ken will be there and…

Teacher (thinking): He is totally and utterly lost when it comes to mathematics. He will never pass the course no matter how much time we put into him from now on. He only disturbs the others. He will never be able to learn mathematics; he's just not got what it takes…

Meanwhile Louise (another pupil) is almost done with the assignment.

Teacher (thinking): But Louise… she has got it right as the first one once again. I should persuade her to do the advanced mathematics next year. Quite unusual for a girl to put this effort into math…

Louise (thinking): Piece of cake! I can't believe the others are so lazy. They don't do anything and exams are just around the corner. I wonder if the exam will have this topic. It's easy!

Ali succeeds in sending his text to the proper destination. He still has no clue about the assignment. It doesn't even enter his mind that it would be possible to solve one single problem with a couple of minutes of hard effort

[4] The expression "ways of talking" refers to the set of ideas and constructed meanings that different actors in the network of mathematics education practices express, implicitly or explicitly, about what mathematics education is and what it involves.

> because he tried that years ago and didn't succeed at all; he has never experienced a "well done" or "correct", only red ink on returned assignments that clearly reads "*you just can't do it"*.
>
> Louise finishes, looks around at her classmates, most of whom are still not showing any signs of doing mathematics. She fiddles her pencil around and flips through her textbook to see if she could find some more entertainment. She is also thinking about the party on Friday and whether she will be able to persuade her mum to buy her that cool blue top she so desperately wants.
>
> The teacher walks around and patiently assists the few students showing a bit of interest in the assignment. He then takes a look at Louise's assignment and is once again surprised at her precision and speed.
>
> Later that summer Louise receives yet another set of top grades and decides to continue with advanced mathematics. She has a dream of becoming a medical doctor so she needs the good grades. She wants to be like her dad and continue the family tradition of going through university. Ali gets one of the lowest term grades in the class and it will only add to a number of grades that are equally low in other subjects, reinforcing his experience of being incapable of learning anything. Just like his siblings and parents. This boy was born with the wrong genes…

One widespread perception of the intrinsic positioning of people in relation to mathematics education concerns the idea that, from the outset, different individuals have different capabilities in learning mathematics. Consequently, it is easy to see how power may be distributed in the setting of a mathematics classroom based on the intrinsic capacities of the students. The cards are, so to speak, already dealt before the educational system enters into operation and as a result the role of the educational system can be seen as simply reinforcing what has already been decided by nature.

This intrinsic perspective can be traced back to one of the most famous interpretations of mathematics, namely Plato's (Plato) conception: All individuals have had a glimpse of the world of ideas —including the mathematical ideas— but not everyone has received the same skills from birth to explore it. Most are born with bronze in their soul and they are therefore best suited for the work of the hand. Some have silver-souls and they best fit the organization of the State as warriors. Few are born with gold in their soul and these are the ones who should do the work of the mind in the State. These people should contemplate mathematical ideas and, after training their thinking with mathematics, they should proceed to the even more difficult areas of work in philosophy such as how to organize the State and deciding what is justice.

Considering distribution of power from a perspective of intrinsic capacity has much in common with Plato's thoughts. This power distribution is found in the ongoing constructions of who can learn mathematics and who cannot. Actors in mathematics education practices may consciously or unconsciously adhere to these ideas and engage with the students accordingly. They may base their choices of teaching strategies and how to relate to students on grounds of gender, race or intelligence. For example, actors operating from an intrinsic perspective could believe that each human being is born with a specific gene-structure which determines his or her capacity to learn mathematics. The resemblance to Plato's conception is quite obvious and in constructing mathematical practices based on perceptions of intrinsic capacity, teachers, parents, politicians and other decision makers design and carry out mathematical instruction according to differentiated ideas about students' capabilities. Politicians might want to propose elite schools, believing that less able pupils may hinder the progress of the stronger pupils. Mathematics education, a privileged means of making "the gold in the soul shine", thus becomes a clear arena for the empowerment of some students and thereby contributing to the inclusion and exclusion of individuals in society based on their perceived mathematical capabilities.

Although rarely addressed openly, the perception of power as an intrinsic capacity in mathematics education is not limited to micro relations between teachers and students but can also be located at a political macro level. Shocking examples are found in different places in different historical times. In Nazi Germany mathematics education was organized by the Mathematics Society as an important factor in training the "new powers" for managing the new regime in an appropriate way[5]. In apartheid South Africa, African students were not perceived as being apt for mathematical learning and were therefore systematically excluded. Mathematics education was used as a tool for the "occupation of the mid" of African students[6]. Another contemporary and less dramatic example is the placement of so-called "elite students" in either separate classrooms or special elite schools for what is considered to be the "geniuses" of a generation. In these examples, mathematics education opens/closes doors to the right/wrong groups of students, based on particular traits deemed compatible/incompatible with the learning of mathematics.

This perception of mathematics education practices seems blind to deeper and more contextual explanations about how, and especially why, some pupils and students are incapacitated with regard to the learning of mathematics. It closes the research on mathematics education off from a number of social and cultural perspectives by assuming a power distribution that is natural and which was already there before; for example, the children in a given class became acquainted with numbers or engaged with the educational system. This perspective on power distribution in mathematics education to a large extent removes real responsibility for students' learning of mathematics from the teachers and other decision makers. The cards are, so to speak, already dealt.

## The technical perspective

> We now shift our focus to a Western European television station. A debate program is running live and we listen quietly from the entrance of the studio – right behind the running cameras.
>
> The Minister of Science and Technology: Unless we modernize and restructure our educational system and particularly the technical and scientific subjects in the years to come we will severely damage the nation's competitiveness. We face two major threats in the very near future. One is the increasing number of elderly citizens who will need support and services even though the workforce is reduced. And secondly increased globalization places new demands on the workforce which has to be educated to compete with the cheap labour in other parts of the world. In the future there just won't be room for uneducated people in the labour market. Work that can be carried out without a higher education will eventually flee the West and be outsourced to countries where wages are

[5] See Mehrtens (1993).

[6] See Khuzwayo (2001) for an analysis of the role of mathematics education in South Africa from 1984 to 1994.

> lower. So we really need young people to go through higher education, preferably half of the population should have a higher education, and as many as possible one within science, technology and engineering.
>
> Interviewer: Globalization will mean high unemployment rates unless we act now?
>
> Minister: We have to evaluate what can be done to ensure that we remain competitive in state-of-the-art science and technology. And we can only ensure this by training our youth in the basic scientific skills. We need to get away from the 1968's small-talk pedagogical methods and start getting serious about teaching our youth the basic skills that can secure our own future as a welfare society with a sound economy and a leading position when it comes to producing and utilizing information and communication technology.
>
> Interviewer: What will become of the young people who have no interest in science and technology?
>
> Opposition leader: As was just mentioned, it is unquestionably necessary to focus on the organization of the educational system. However, with the Government's proposals only the elite will benefit. It will not be possible to educate more young people at universities if entry requirements are continuously increased and the range of different educational offers limited. Not everybody can have an interest in science and technology and it seems crucial not to forget the contributions of the social sciences and the humanities to our welfare state.
>
> Minister: We are simply scoring too low in the international tests on mathematics and science year after year. Unless we strengthen the focus on these subjects our competitiveness and ability to be in the forefront of technological advances will simply disappear.
>
> We quietly leave the studio and head back home. Undoubtedly the educational system is headed for yet another reform strengthening subjects like mathematics and science in the primary schools and technology in higher education in the attempt to secure a sound economy for the State and the high standard of living in the years to come.

In the technical perspective, mathematics is considered as a tool or technique for enhancing our lives both as individuals and as members of a society that strives to become richer —and possibly happier too. Mathematics is believed to be an important ingredient in the rational construction of modern societies, an important tool for the control of threats of nature on humans, and a fundamental piece in the advancement of high-tech production in a global market economy. This view is not new. It has been on the go in the Western world —and is expanding to the rest of the globe— since the time of the Sputnik Shock in the 1960's.

Mathematics is powerful and the role of mathematics education is to transfer that power to as many citizens as possible. In this technical perspective, power distribution occurs at both a micro and a macro level. At a micro level, power is distributed through the individual's conscious or unconscious choices and priorities in relation to their educational portfolio. Individuals are continually presented with possibilities and limitations when it comes to learning mathematics. Very often mathematics is not something the individual chooses out of interest but rather because the educational system demands mathematical capacity to pursue a particular prestigious line of education, for example, to be allowed to study medicine, science or engineering[7]. Students are continually encouraged by parents, teachers and through the media with information about how they could gain from learning mathematics, how mathematics opens up opportunities and how not learning mathematics will inevitably close some important doors.

At the macro level, politicians and educational researchers and planners consider the technical skills of the workforce as a whole. As was illustrated in the narrative above, politicians often point attention to the need for the workforce to be moulded and shaped to cope with social needs —in our present time, the rapid changes in the global market economy. To know about mathematics is believed to be a powerful position both for the individual and for society as a whole. Not knowing about mathematics, on the other hand, is considered a less advantageous position whereby power is surrendered to other actors, for example, people, companies or societies with greater technical capacity in mathematics.

In mathematics education research the idea of power being distributed according to technical skills is widely supported. Here we present an example that clearly reflects these views. In the *Handbook of International Research in Mathematics Education,* English (2002) invites contributing authors to think about the issue of access to powerful mathematical ideas. In the book, English gives meaning to the term powerful, in the following way:

[…] the lack of access to a quality education—in particular, a quality mathematics education—is likely to limit human potential and individual economic opportunity. Given the importance of mathematics in the ever-changing global market, there will be increased demands for workers to possess more advanced and future-oriented mathematical and technological skills. Together with the rapid changes in the workplace and in daily living, the global market has alerted us to rethink the mathematical experiences we provide for our students in terms of content, approaches to learning, ways of assessing learning, and ways of increasing access to quality learning. (p. 4)

She supplements her explanation in the following manner:

Students are facing a world shaped by increasing complex, dynamic, and powerful systems of information and ideas. As future members of the workforce, students will need to be able to interpret and explain structurally complex systems, to reason in mathematically diverse ways, and to use sophisticated equipment and resources. […] Today's mathematics curricula must broaden their goals to include key concepts and processes that will maximize students' opportunities for success in the 21st century. These include, among others statistical reasoning, probability, algebraic thinking, mathematical modeling, visualizing, problem solving and posing, number sense, and dealing with technological change. (p. 8)

In these extracts, English highlights the power of mathematics in relation to technology and development. The power to ensure such technical capacity lies with practices of mathematics education. The issue of exclusion is brought forward: Not all individuals have access to quality mathematics education and, consequently, they do not have the same opportunities of life as others who have received appropriate mathematics education. The former will simply lack the skills —the mathematical know-how and techniques— that are essential for being able to cope with working life

[7] Mellin-Olsen (1987) presents a discussion of instrumental reasons for choosing to engage in mathematical learning.

in a highly technological society. This is micro-level reasoning about the powerful skills an individual can obtain through mathematics education. The workforce as a whole, however, is also addressed with a special focus on the connection between a global market economy and the mathematical skills required to succeed in it.

Following this line of reasoning, mathematics education is directly linked to competition. Through mathematics education power is distributed to individuals who battle to acquire the best skills in mathematics with the aim to succeed in life. Who can finish the assignment first? Who has the best mathematical (technical) skills for the job? The competition among individuals, however, is mirrored by a fierce competition among schools and even among nations. Schools are to an increasing extent being graded according to the level of mathematical skills their students demonstrate on exams and national tests. Nations use test results to compete on the international arena and political decisions about the educational structure are often based on this competition. International tests on mathematical skills are frequently linked to the economic wellbeing of the nation. Poor test results are interpreted as a clear sign that educational reforms are needed. Governments invest money in various developmental initiatives and in more research with the hope of improving a situation perceived to have potentially catastrophic economic consequences for a country[8]. These scary scenarios influences the distribution of power at all levels and influences decision making regarding mathematics education from politicians in parliament to school organization of resources and teaching capacities.

It can be seen that what we have termed the technical perspective on power distribution in practices of mathematics education is clearly different from the intrinsic perspective. It does not see mathematics as something in which only some human beings were predestined to excel. Rather it suggests that, in principle, everyone can and should learn and acquire mathematical skills, thereby obtaining the power that lies inherently in these trainable competencies. It is often forgotten, however, that not everybody can win when power is distributed through competition. Some individuals will eventually lose and some nations most certainly will too.

## The structural inequality perspective

> A teacher is in a three-day seminar on mathematics and social equity. The main issue being addressed is whether pupils' social background plays a role in determining their performance in mathematics and their advance and participation in the educational system in general. This is considered to be a challenge for democracy and society.
>
> Mathematics education researcher: Mathematics functions as a keyhole in today's society. It is not like some were born good mathematicians and some were born bad mathematicians. And it is equally false to assume that the main purpose of mathematics education is to support our competitiveness in the global economy. If we made that our goal we would need education that is much more focused on the business world and not so much on the generation and regeneration of our cultural fundamental values, beliefs and customs. No! Mathematics education plays the role of

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8 Just as an example, the results of international comparative studies such OECD's Second International Adult Literacy Survey (SIALS) motivated the reform of the vocational training of adults in Denmark with the aim of providing a better chance for adults with a short, basic education to improve their numeracy skills (Johansen, 2006).

maintaining a clear stratification between social classes: working class, middle class, upper class etc. Why does this pose a problem to society? It is a problem because we believe ourselves to live in a democratic society where every citizen is given equal rights and opportunities to live out their ambitions and desires. In class divided societies, people from social A teams and B teams will have their social class reinforced by the educational system —in particular through the most abstract and speculative discipline, mathematics. They will only under very special circumstances be able to break with their social inheritance. We will not obtain equity in the mathematics classroom until we obtain it in the surrounding society!

Teacher (thinking): That's true but we always try to work with the parents in order to ensure the inclusion of the children from under-privileged homes. What else can we do?

Other teacher (discussing): I can see your point about the classes but I think it is a bit old fashioned? One of the challenges I face in my daily work is dealing with immigrant students. They are the type of students who need special attention in everyday mathematics education. They have trouble with language, with the learning style; we try to encourage them, and so on.

Mathematics researcher: There may be different types of lower classes in today's society as compared to the 20th century division of classes according to socio-economic status. People coming from different cultural backgrounds! I can only begin to imagine the implications of this in the classroom but unless these students too are given access to mathematical knowledge and skills, they will have fundamental problems with participating in a democracy on equal terms with other citizens, I should say.

The structural inequality perspective on power distribution addresses the issue of the participation of large groups of the population in mathematics education practices in relation to the larger social structures in which such participation takes place. The activity of giving meaning to mathematics education practices, in different sites and scenarios and by different actors, is connected with broader social processes through which people are classified as included or excluded. The power associated with the possession of mathematical competencies is distributed —willingly or unwillingly— following existing social divisions on the grounds of class, gender, culture, ethnicity, race and religion, among others. This perspective is often concerned with how researchers, teachers, policy makers, students themselves and other actors within the network of mathematics education practices construct new (or reinforce old) structures of exclusion in and through the teaching and learning of mathematics.

The work of Marilyn Frankenstein exemplifies some of the main characteristics of this perspective. Frankenstein (1995) writes:

> "So, I argue that mathematics education in general, and mathematics in particular, will become more equitable as the class structure in society becomes more equitable. Since I also contend that working-class consciousness is an important component in changing class inequities, developing that consciousness during teaching could contribute to the goal of ensuring equity in mathematics education. […] I think that mathematical disempowerment impedes an understanding of how our society is structured with respect to class interests." (p. 165)

In this passage, Frankenstein acknowledges social class divisions and how mathematics education is immersed in it. Mathematics education and mathematics cannot be equitable practices since they are implicated in class stratification. The role of adopting a critical stance towards this situation, which is not frequently recognized by, for example teachers or researchers adhering to the intrinsic or the technical perspective, is promoting class-consciousness and awareness in students. Mathematical knowledge and competencies are essential to unravelling deep structural inequalities. Students can be empowered through mathematics teaching and learning that promote such awareness.

Another example of the structural inequality perspective is to be found in the political challenge posed by ethnomathematics to the reign of Western, white mathematics. A fundamental critique by D'Ambrosio (1993) is the uncontested imposition of mathematics as the privileged form of the thinking of human beings. Because of its high status in the Western world, mathematics 'is positioned as a promoter of a certain model of exercising power through knowledge' (p. 24, authors' translation). Through the historic development of the West —which has a well-documented impact on the transformation of people in other parts of the world— mathematics has imposed the rationality of the dominant power over other ways of thinking and expression in non-Western, indigenous, colonized cultures. Powell (2002) also highlights that ethnomathematics departs from forms of thought that privilege "European, male, heterosexual, racist, and capitalistic interests and values" (p. 17). This essential critique to mathematics as a tool of ideological domination is incorporated in research and in the pedagogical proposals derived from it.

As exemplified above, the structural inequality perspective assumes an unequal, gender-, race-, ethnicity-, ability-, culture- and class-divided society —which differs from the kind of global, market society to which English (2002) refers. At a macro level, the general inequalities in society are reproduced through the ideological apparatus of the State. At a micro level, inequality is maintained in and through several practices and sites, particularly in schools and, within them, mathematics classrooms. Power is seen as the capacity of the owners of productive, social or cultural resources to promote their interests through the alienation of other groups from such resources. As a result, a situation of oppression and dispossession of the latter is created. The "excluded", however, may resist in an attempt to regain control over resources in order to pursue their own interests. The initiatives of critical people to help the excluded break their alienation and, in doing so, demand a space in the distribution of power are also important.

In the arena of mathematics education practices, empowerment through mathematics can be seen as the capacity that an individual gains, via the learning of mathematics, to see the way in which mathematics operates in society and contributes to perpetuate an unequal class distribution. Learning mathematics can be an element in breaking with injustice. Mathematical disempowerment, on the other hand, contributes to the general alienation of people as part of the operation of the capitalist system. Empowerment, though, is not a result of an individual enlightening process but rather a social process in which the disempowered are assisted by others in order to gain consciousness.

Although the way of talking about society and the misdistribution of access to resources is different in the technical and the structural inequality perspectives, their views of power do not seem significantly different. The idea that the learning of mathematics provides students with a capacity to act in the social world is similar, although the justifications for its relevance and for its utility are quite different. These two perspectives also differ in their view of the kind of actions that can be undertaken with the use of mathematics. While in the technical perspective mathematics is seen as a positive constructive tool, in the structural inequality perspective it is seen as a capacity that is used in destructive ways —and sometimes in constructive ways, as a result of resistance.

## The Three Perspectives in Research

Above we have shown how power and power distribution can be viewed from three different perspectives in the network of mathematics education practices. Each of these perspectives shed light on the dynamics of power distribution at both micro and macro levels and each perspective contains its own narrow scope for analyzing practices of mathematics education. In these concluding remarks we wish to point to the way in which each perspective can be linked to the practice of research in mathematics education. Each perspective opens to different research possibilities and consequently distributes particular powers and responsibilities to the researchers involved.

From an intrinsic perspective, mathematical skills are strongly linked to the individual as something one may or may not be able to acquire depending on particular traits and characteristics. Mathematics education here provides the framework for nurturing these skills for essentially different groups of people. In this perspective mathematics education research would naturally focus on understanding the difference in conditions offered by nature in acquiring mathematical skills. This could, for example, be research in intelligence or genetics.

In the technical perspective, the learning of mathematics can be considered not only as the individual's acquisition of a particular skill for his/her own use, but also as a skill residing in society. At a national level, mathematical skills contribute to improving competitiveness and economic interests of the nation. This view naturally opens for research in teaching strategies and learning environments and the research has a direct obligation to contribute to the enhancement and effectiveness of these strategies and environments.

In the structural inequality perspective, it is emphasized that mathematics education can play both a constructive and destructive role in society. This is evident when mathematics education is utilized in order to promote equality or, on the contrary, when it favors particular social groups with the consequence of marginalizing other groups. Research from this perspective evolves around inclusion strategies of groups that are perceived to be marginalized – for example, students of poor socio-economic backgrounds, women and immigrants.

Research in the three perspectives can, each in their own way, be related to the distribution of power in the network of mathematics education practices. Research will promote certain perspectives on mathematics education and downscale other perspectives. In doing so, research is directly contributing to the continuous reshaping of the landscape of power distribution in mathematics education practices.

The question remains, however, whether the three perspectives cover the landscape of power distribution. Are they merely traditional research paradigms and therefore rarely challenged? Is the landscape already challenged indirectly by the setup of this chapter? And what would alternative perspectives look like if they were not the intrinsic, technical or structural inequality perspectives?

## A Landscape of Power Distribution

Diana: Three perspectives on power have been outlined but they don't quite qualify as the full story about this issue. I think the best way to put it is to say that they are our analytical constructions. We could have chosen many other perspectives that would have presented different aspects of the distribution of power in the network of mathematics education practices.

Ole: For example we could have structured the article from the perspective of different types of agents involved in mathematics education; a teacher, a pupil, a researcher, an educational policy maker, a curriculum designer etc.

Diana: All in all they are three arbitrary perspectives but, nonetheless, not chosen out of the blue. They are the perspectives that we found to be very strong narratives about how power is distributed in the network of mathematics education practices and which are often found in contemporary mathematics education research. The first one could be considered as a kind of anti-contextual perspective that basically interprets the actual power distribution among individuals as based on non-social mechanisms. The philosophy inherent in this perspective raises deep issues about our cultural perception of mathematics and the practices of mathematics education. It favours a perception of mathematics where the world of mathematics is distanced and independent of the human social sphere. Hence, the mathematics education practices need not be too concerned with the social or cultural background that students bring with them into the classroom; or the micro processes that go on in the classroom. I think this perspective dramatically limits the potential for understanding why some have an easy time doing mathematics and why some struggle all their lives.

Paola: I agree. In contrast, it is interesting to see how the technical and the structural inequality perspectives are less static in their portrayal of who can learn mathematics and who cannot. They both present to us the idea that anybody could ideally become fluent in mathematics and in their dynamic approach they rely on the idea of progress. Both perspectives adhere to the idea that mathematics can be a liberating tool for humans against threats from nature or suppression; that mathematics as part of the technological core of our society will ensure a better society all together. Better technology equals a better social sphere. This is questionable to say the least. It is the idea that von Wright (1994) has termed "The Myth of Progress".

Ole: Somehow the technical and the structural inequality perspectives could be thought of as modern frameworks for understanding mathematics education practices. Either you believe that through mathematics people can be given a tool for bettering their life or you believe that some are given this tool while others are excluded from acquiring it. I could imagine an alternative perspective characterized by less reliance on the progress followed by acquiring this tool. It would be reflective about the transparency of the goals of mathematics education and favour an interpretation of mathematics that focused on its social origin.

Paola: Relating to a postmodern position for thinking about mathematics education, Thomas Popkewitz (2002, p. 35) has offered some interesting insights. He writes about the mathematics curriculum as an ordering practice analogous to creating a uniform system of taxes or the development of a uniform system of measurement that works as an inscription device, making the child legible and administrable. From this position the mathematics curriculum embodies rules and standards of reason that order how judgments are made and conclusions drawn so that the fields of existence are made manageable and predictable. Also, Popkewitz quite agrees that mathematics education carries the narrative of progress in a global knowledge society.

Diana: One could say that from Popkewitz' position, mathematics education is a social practice which, together with other sets of practices, contributes to the governance of citizens and their possible participation or exclusion from participation in the social world. This governance is carried out through the instauration of systems of reason, which are socially constructed and accepted forms of characterizing and organizing the world. These systems frame what is possible, desirable and appropriate and therefore what constitute the basis of classification of individuals in a society. The mathematics curriculum and the teaching of mathematics are not exclusively devices and processes in charge of the transmission of mathematical knowledge. Mathematics education operates as part of broader mechanisms which determine what is valued, what is right and what is normal in society.

Ole: Popkewitz' formulations, then, can be characterized as being representative of an alternative perspective on the distribution of power, namely one that emphasizes the social dimensions of mathematics education. This perspective could be supported by the later Wittgenstein's (1978) conception of mathematics when he talks about mathematics as a measure, and not as the thing being measured. He persistently pursues the idea of mathematics as normative rules – mathematics is on a pedestal because it outlines ways of reasoning that cannot be reasonably questioned once they are accepted as proved. In this Wittgensteinian framework, there is only our use of the signs of mathematics that determines their meaning. Mathematics is a language game – one we are gradually socialized into as we train over many years in both school and out of school practices.

Diana: I think Wittgenstein's concept of language game is a possible framework for understanding the distribution of power in the network of mathematics education practices. We could think about 'mathematics education' as a network of language games that overlap each other in a complex pattern – they share family resemblances in Wittgenstein's (1997) terminology. The language games inherent in the field of 'mathematics education' all share the condition that they are open-ended scenes for social interaction. A fundamental aspect of a language game is the continual development and power struggle through every utterance about how the game is to be played. Every utterance or action is a move in the game that changes the game – sometimes only infinitesimally and at other times the change is radical. We play with the rules of the language games of which we are part. People position themselves in the game, with power eventually being distributed among the players.

Paola: If we return to Popkewitz' perspective, his ideas are actually highly inspired by Foucault's analysis of the microphysics of power in modern societies (see, for example, Foucault (1972) and Foucault & Faubion (2000)). I think it supplements Wittgenstein's basic arguments about how our language and interaction works well by focusing more directly on the notion of power. In this view, power is a relational capacity of social actors to position themselves in different situations, through the use of various resources. This definition implies that power is not an intrinsic and permanent characteristic of social actors; instead, power is *relational* and in constant transformation. This transformation does not necessarily happen directly as a consequence of open struggle and resistance, but through the participation of actors in social practices and in the construction of discourses. In this sense, power is not openly overt but subtly exercised.

Ole: This also means that power is both a constructive and a destructive force, and that this duality is always present in any social situation. When power is defined in these terms, it becomes possible to enter into a very fine-grained analysis of how mathematics and mathematics education are used in particular discourses and of the effects of those discourses on people's lives. This definition could possibly bring new insights to research because it finds resonance not only with the advance of postmodern ideas in education (see, for example, Popkewitz & Brennan (1998)), but also with new possibilities for reinterpreting many of the theories that have been at the core of the discipline of mathematics education.

Paola: In the recent book *Mathematics Education within the Postmodern* (Walshaw, 2004), there is a series of articles adopting similar perspectives on power. Hardy, for example, presents a toolkit —a series of notions coming from Foucault (1972)— which has helped her see how power is exercised in mathematics classrooms in the relationship between students, a teacher and school mathematics activities. Through the examination of a video excerpt from teacher training material published by the UK government as part of the National Numeracy Strategy, she presents an interpretation of the interaction between teacher and students in which the teacher's pedagogical techniques are in operation.

Diana: Ahh, I remember that one. From Hardy's perspective the teacher creates a situation of surveillance in which students' actions are exposed to the control of the teacher, who publicly approves and disapproves their answers to calculations. Students are not only "answering" to the teacher's demands, but they are being identified with an answer and are learning to identify themselves with an accepted (or rejected) behavior and thinking. The teacher's way of managing the classroom discourse plays with the double strategy of individualizing (that is, making noticeable in public an individual action) and totalizing (that is, hiding individuals within a collectivity) through her constant distinction between particular students (with proper name) and the collectivity of the class (the "we" referring to "all" in the classroom). This strategy is used in systematic ways: individualization is used to publicly correct wrong answers and to reward right answers, thereby creating a clear differentiation between those who cannot and those who can do the mathematics. Totalization, on the other hand, is used to give a collective legitimacy to what the teacher considers to be appropriate behavior. I think Hardy's analysis illustrates that the power dynamics of a classroom go deeper than the expected mathematical empowerment assumed by the views of power found in the intrinsic, the technical and the structural inequality perspectives that we have presented.

Diana: Well, now we have discussed some general perspectives on power distribution in mathematics education practices, but we still have not addressed how the landscape of power distribution affects our practice as mathematics education researchers and how the mathematics education research is related to other practices of mathematics education. If we cannot depart from only one perspective exclusively such as the intrinsic, the technical or the structural inequality perspective, and if we are to maintain an active acknowledgement of the complexity of power distribution in the landscape of mathematics education practices, how do we engage in research and how can we interpret our own roles as researchers as part of the complexity of power distribution?

Ole: From a postmodern position, research and the researcher can never be neutral or detached, standing outside the mathematics education practices peering inside. Power is inevitably distributed one way or another when the practice of mathematics education research meets with practices of, for example, teaching or curriculum design. Tamsin Meaney (2004) has used Foucault's idea of power as embedded in social actors' relationships in order to analyze her role as a white expert consultant when working with a Maöri community, socially positioned as a disadvantaged community, in the development of a mathematics curriculum. In her analysis of the changing positions that both her and the community acquired during the inquiry process, she highlights that what came to be considered as valid knowledge and truth was deeply dependent on the way in which the relationship among the project participants evolved. She argues that power fluctuated among participants in their differential use of strategies to argue for and give meaning to the knowledge being constructed in their relationship.

Paola: Actually, several scholars (Cotton & Hardy, 2004; Meany, 2004; Valero, 2004) have recently argued that an analysis of power in these terms is not restricted to the practices of teaching and learning where school mathematics is implicated. The analysis should also extend to the way in which research is produced. Researchers, in their privileged position as active constructors of knowledge (and with it, of discourses about what is valid) participate in the consolidation of certain systems of reason. As Popkewitz (2004) argues, "intellectual traditions of research construct ways of thinking and ordering action, conceive of results and intern and enclose the possibilities imagined" (p. 259). In this sense, researchers' discursive practices are not a neutral search for truth but an active engagement in opening/closing possibilities for phrasing and giving meaning to the social world. Therefore, this view opens for an examination of the way in which researchers are also implicated in the social distribution of power.

Diana: When considering how research and researchers are part of the web of power distribution in the network of mathematics education practices, I cannot help thinking about how we can easily be instrumental in establishing specific perspectives and imaginaries about mathematics and mathematics education. For example, if we only address power distribution from a technical perspective, we distribute a perspective that does not address the destructive powers also associated with mathematics education. Simultaneously, we can be influenced in our research by other mathematics education practices and social constructions. We should never underestimate our own roles in influencing mathematics education practices through our research. Is it not exactly a tool for that purpose—to influence practice?

Paola: So in other words, we're sitting here now— three researchers of mathematics education talking to other researchers in the field—and it appears crucial to always remember that we too are part of the network of mathematics education practices. Take for example this response, what is it we wish to achieve? Are we not trying to influence the way in which others think about mathematics education and the distribution of power? More specifically, are we not trying to influence the way in which others 'read' and interpret what *we* think about mathematics education and the distribution of power?

Ole: I think this is what every researcher is trying to do. Mathematics education research is about constructing standpoints or perspectives on power distribution. In a way, this is an ethical challenge that is always part of the research agenda. It could be thought of as always taking seriously the rather philosophical question: Why is mathematics considered a powerful enterprise in Western culture?

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# Authors’ biographical info

## Ole Ravn Christensen

Ole Ravn Christensen, PhD in science and mathematics education, Assistant Professor in the Department of Education, Learning and Philosophy at Aalborg University. His initial background is in mathematics and philosophy. Since 2000 he has been doing research in the area of the philosophy of mathematics, mathematics and science education, with particular emphasis on the social and historical dimension of mathematics teaching and learning, and of science education. His research integrates studies on learning theories, philosophy of science and the practice of education and educational planning. He has published several papers in books and journals.

## Diana Stentoft

Diana Stentoft, PhD candidate in the Department of Education, Learning and Philosophy, Aalborg University, Denmark. Her background is in language and international relations. Her thesis research is focused on student and teacher identities as they are brought into the mathematics classroom context and their influence on the teaching and learning of mathematics. She works from a multi-disciplinary perspective integrating social and post-structural analysis.

## Paola Valero

Paola Valero, PhD in mathematics education, Associate Professor in the Department of Education, Learning and Philosophy at Aalborg University. Her initial background is in Linguistics and Political Science. Since 1990 she has been doing research in the area of mathematics education, with particular emphasis on the political dimension of mathematics teaching and learning, and of mathematics teacher education. Her research integrates sociological and political analysis of mathematics in different institutional settings, and different aspects of mathematical learning and teaching. She has published several papers in books, journals and conferences proceedings.